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ORIGINAL

The Effect of an Extended Flipped Classroom Model for Fully Online Learning and its interaction with Working Memory Capacity on Students' Reading Comprehension

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ABSTRACT

The flipped classroom model is an innovative and increasingly popular pedagogical approach in higher education. However, despite its increasing popularity, few studies have elaborated on specific strategies to implement a flipped classroom model. This study has as its purpose to investigate the effect of an extended flipped classroom model for fully online learning and its interaction with working memory capacity on students' reading comprehension by means of a quasi-experimental study with a 2 x 2 factorial design in which a total of one hundred and twelve students participated for nine weeks. The two-way analysis of variance revealed that students' reading comprehension ability increased significantly in the extended flipped classroom model compared to that of students in the original flipped classroom. Students with a high WMC also largely outperformed their counterparts with a low WMC in reading comprehension, an interaction effect being thus identified between the instructional model and WMC as well. This paper concluded with a call to implement an extended flipped classroom model in reading courses and to undertake more specific types of research into the effectiveness of this model across different settings and language skills.

Keywords RECIPROCAL TEACHING, INSTRUCTIONAL MODEL, READING COMPREHENSION, FULLY ONLINE FLIPPED CLASSROOM

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1 INTRODUCTION

Enhancing students' performance in specific areas such as reading comprehension of English as a foreign language (EFL) becomes essential to support them and to help them achieve academic success in higher education contexts (Cahyono & Widiati, 2006; Harizaj & Hajrulla, 2017). However, crucial issues in the improvement of these performances have been reported by several studies. For example, Hashemifardnia, Namaziandost, and

Shafiee (2018) stated that he process of understanding and constructing meaning from a piece of text was not performed well enough by students. Samiei and Ebadi (2021) pointed out that the comprehension of the context behind the symbols, alongside the discovery of the link between words and concepts were regarded as significant and challenging skills during the language learning process. Another research work equally found that students suffer from weaknesses in their ability to identify the main ideas of passages, to detect the author's purpose and tone, to guess the meaning of words in context, and to draw conclusions as well as to make inferences Khodary and Abdallah (2014). In line with this, Indonesian learners also show limitations in such skills as identifying cause-and-effect relationships, recognising contradictions in a text and evaluating arguments (Par, 2018). Additionally, while most students have sufficient declarative knowledge of reading skills, amongst them critical reading comprehension, their procedural and conceptual knowledge about those skills turned out to be inadequate (Mbato, 2019).

Recent developments in active-learning pedagogical approaches together with advances in instructional design and technology have led some researchers to encourage the implementation of an instructional model —the original flipped classroom (OFC)— that offers considerable promise for the future. For instance, a literature review study found that OFC utilisation in various disciplines is mainly advocated to promote students' engagement, metacognitive attitude, performance and achievement (Al-Samarraie, Shamsuddin, & Alzahrani, 2020). A meta-analysis study that focused on higher education showed that the OFC model has a moderately positive effect on students' learning motivation and achievement levels (Zheng, Bhagat, Zhen, & Zhang, 2020). Another meta-analysis study in turn revealed that the OFC model has a moderately positive effect on student performance too (Strelan, Osborn, & Palmer, 2019). More recently, a systematic review study about the outcomes of the OFC model highlighted an increase in student performance, as well as a positive influence on cognitive, affective and soft skills (Birgili, Seggie, & Oğuz, 2021). Nevertheless, further research on actual students' performance is needed to investigate the effectiveness of the OFC model (Cho, Zhao, Lee, Runshe, & Krousgrill, 2021; Kim, Kim, Khera, & Getman, 2014), particularly in new settings such as fully online learning (Stöhr, Demazière, & Adawi, 2020).

Despite the various advantages associated with using the OFC model, its implementation comes with several challenges for teachers and students from different disciplines. Thus, a study by Birgili et al. (2021) showed that OFC implementation in diverse domains —e.g. engineering and technology, mathematics, medical and health sciences, social sciences and humanities, natural sciences and education— concluded that the main challenges posed by this model included: the time required for students to master the learning material; the lack of immediate feedback; and course structure. Along these same lines, another work dedicated to flipped language learning showed that teachers had difficulty ensuring the successful completion of the pre-class learning session by all students, as well as in relation to the design and development of the teaching material and of the activity to be developed in the flipped classroom. As for students, their greatest challenge concerns independent learning for the pre-class session. Some students considered the pre-class session workload too heavy

and others could not follow the flipped classroom scheme. All of this logically affects the subsequent in-class session, in which their inability to participate actively will make them feel frustrated (Zou, Luo, Xie, & Hwang, 2020).

Working memory capacity (WMC), which stands out amongst the most widely examined cognitive factors of reading performance, refers to an individual differences construct reflecting the limited capacity of a person's working memory (Wilhelm, Hildebrandt, & Oberauer, 2013). The finding shared by several studies points at the existence of a significant relationship between students' WMC and reading performance. For example, a meta-analysis carried out by Daneman and Merikle (1996) revealed that WMC not only was linked to reading comprehension but also served as a strong predictor for the performance in this skill. Moreover, according to a study by Pérez, Paolieri, Macizo, and Bajo (2014), students with a high WMC were more accurate when giving explanations and also proved faster at making predictions than students with a low WMC. Similarly, another research work also found that students with a higher WMC comprehend texts better than those whose WMC is lower (Heriyawati, Saukah, & Widiati, 2018). It follows from all the above that students with a higher WMC will outperform those who have a lower WMC.

Faced with this backdrop, developing well-organised instructional —both online asynchronous and synchronous— sessions becomes necessary to support the successful implementation of the flipped classroom instructional model (Diningrat, Setyosari, Ulfa, & Widiati, 2020), especially during the pandemic. With this aim in mind, several studies suggested using a robust design theoretical framework (Karabulut-Ilgu, Cherrez, & Jahren, 2018; McNally et al., 2017) and taking the subject area feature into consideration, as well as analysing the learning contents and requirements (Cheng, Ritzhaupt, & Antonenko, 2019). In this study, our attention has focused on the design of a theoretical framework for reciprocal teaching. One of the main reasons is that reciprocal teaching provides a theoretical sound avenue to foster a deeper understanding of texts and accordingly to improve reading comprehension levels (Doolittle, Hicks, Triplett, Nichols, & Young, 2006). Furthermore, due to the fact that educators have increasingly adopted online teaching and learning amid Covid-19, this study aimed to develop an extended flipped classroom model within a fully online environment that incorporates the reciprocal teaching strategy, which not only fits the characteristics of the reading pedagogy but also makes it easier for students to enhance their reading performance.

1.1 Flipped Classroom in English Language Teaching

It is a well-known fact that language acquisition requires time, patience, and practice; thus, EFL classroom students should be able to engage in as many activities as possible to attain a better learning goal (Turan & Akdag-Cimen, 2019). Due to the fact that a teacher-centred approach has a limited opportunity for practice, it becomes necessary to follow a student-centred approach that focuses on active learning. The flipped classroom instructional model can give a student in language learning with more opportunities to practice during the classroom time by restricting the teacher's lecturing to the time spent outside the classroom (Bergmann & Sams, 2012; Turan & Akdag-Cimen, 2019). Typically, the OFC model

has two learning sessions: the first one revolves around pre-class learning activity, while the second centres on in-class learning activity. Bishop and Verleger (2013) stated that pre-class learning activity fosters computer-based individual learning, whereas in-class learning focuses on collaborative work. Moreover, pre-class learning activity aims at the mastery of the basic knowledge content; instead, in-class learning activity revolves around practicing and applying the basic knowledge to solve a problem Diningrat et al. (2020).

Several recent studies have proposed three-stages for flipped classroom activities and investigated their effectiveness. A systematic review study found that the learning activities in a flipped language classroom consist of three stages, namely: pre-class; during-class; and after class Zou et al. (2020). Moreover, the results revealed that pre-class activities paid more attention to listening and reading, in-class activities placed greater emphasis on the comprehension practice of knowledge and skills, and after-class activities essentially revolved around comprehension practice and writing. In line with this, the study by He (2020) proposed a three-stage asynchronous blended flipped classroom instructional mode that includes pre-class, in-class and after-class learning activities. He (2020) also highlighted that this model not only contributes to improving students' academic performance but also encourages them to use their reflection in the after-class learning activity. Another study by Chiang and Wu (2021) likewise proposed a three-stage collaborative instructional model (3-CI) for graduate students once again organised around three main stages of learning activity, i.e. pre-class, in-class, and after-class. Their findings showed that 3-CI implementation increases students' satisfaction, engagement and collaboration (Chiang & Wu, 2021). Based on the three above-mentioned models, after-class learning activity seems promising to encourage students' critical thinking in reading through their reflection on, and evaluation of texts.

1.2 The effects of the Reciprocal Teaching Strategy on Reading Comprehension Performance

Reciprocal teaching is a researcher-developed instructional strategy designed by Palinscar and Brown (1984) to boost students' reading comprehension skills. They stated that, when it comes to improving reading comprehension skills, students are scaffolded by the instructional procedures through four comprehension-fostering and comprehension-monitoring strategies. For example, students' own predictions of what is going to be discussed in the text, their own questions based on it, clarifying what the student does not understand in the text, and summarising through the use of students' words drawn from it. According to Tarchi and Pinto (2016), learners construct the meaning of the text through a dialogue in which they assume the role of teachers for their classmates, along with the responsibility to lead the dialogue or discussion, all of which facilitates everyone's learning through peer feedback and peer tutoring. Additionally, the reciprocal teaching strategy could serve to improve skills related to literacy skills such as reading comprehension (Gruenbaum, 2012).

The reciprocal teaching instructional strategy emphasises the importance of using a reading comprehension methodology in which a group of students apply all four learning strategies (i.e. predicting, questioning, clarifying and summarising) collaboratively in

order to construct the meaning of a written text (Tarchi & Pinto, 2016). Several studies have suggested that the implementation of these four comprehension strategies could lead to a significant improvement in reading comprehension, critical reading, and critical thinking skills (Palinscar & Brown, 1984; Tarchi & Pinto, 2016; Yang, 2010).

Furthermore, the prediction strategy refers to students' assumptions about what topics may be discussed in the next that follows, for which purpose they must activate their previous knowledge related to the topic dealt with in the text. Practicing this strategy increases students' ability to monitor their reading comprehension. As for the questioning strategy, it requires that learners generate questions about the main idea and provide supporting information; they will likewise need to view their peers' perspectives on those same issues. This strategy demands from students that they master supporting information and draw inferences from the reading text. Putting this strategy into practice effectively enhances students' ability to read and understand the text. As its name suggests, the clarification strategy has as its aim to clarify any possible misunderstandings concerning the text. In this strategy, students are asked to assess their own comprehension and to ascertain whether the text is difficult to comprehend, due to the presence of new concepts and vocabulary, unfamiliar concepts or reference words, amongst other things. This strategy additionally pursues to ensure students' comprehension when reading the text. Finally, the summarising strategy is a process which involves deleting unimportant information and identifying or constructing general or main idea statements into which many details become integrated. This strategy also needs students to identify the main idea, as well as the important details, while reading, synthesising ideas across paragraphs, and providing a summary based on a single paragraph, a section of the text, or an entire passage.

In addition to the above, previous studies have investigated the effects of the reciprocal teaching strategy on students' critical reading performance. For instance, by engaging students simultaneously in specific comprehension strategies: prior knowledge activation, identification of keywords and definitions (during the reading process), summary rewritings (after reading the text) and reflection (following the discussion in class) could promote critical reading comprehension and thinking skills (Doolittle et al., 2006). A quasi-experimental study undertaken by Ahiri, Yuniarsih, and Rasto (2018) demonstrated that the critical thinking skills in reading of students taught using the reciprocal teaching strategy are better than those of learners taught otherwise. It can therefore be inferred from these studies that the implementation of the aforesaid four comprehension strategies results in a significantly improved reading comprehension performance.

1.3 An Extended Flipped Classroom Model to Enhance Students' Reading Comprehension

The development of students' reading comprehension including that of first-year university learners is an important and urgent issue facing higher education institutions today. Reading comprehension must rely on an effective reading to implement such practices as relating students' background experience to the text, summarising information, drawing conclusions and posing questions Allen (2003).

In an attempt to build a teaching framework to help adult students improve their reading performance, this study adopts the conceptual framework designed by Marschall and Davis (2012) and based on Kolb's experiential learning theory (Kolb, 2001) together with the strategies for critical reading proposed by the reading specialist Harvey (Harvey & Goudvis, 2007). Harvey's learning stages can be broken down into: activating and connecting; questioning; visualising and inferring; and summarising and synthesising. The intersection of these two approaches consequently suggests a three-stage framework that consists of pre-reading, experiential reading and after-reading (Marschall & Davis, 2012).

Moreover, both the aforementioned reciprocal teaching strategy procedures — predicting, questioning, clarifying and summarising (Palinscar & Brown, 1984)— and the conceptual framework to teach adult college students reading comprehension Marschall and Davis (2012) fit very well with the flipped classroom instructional model which envisages three phases in learning activities, namely: pre-class, in-class, and after-class sessions (Chiang & Wu, 2021). This study designed and developed an extended flipped classroom model integrated into the reciprocal teaching strategy for a fully online context that comprises three main stages of learning activity: pre-class; in-class; and after-class activity, as seen in Figure 1.

During the pre-class stage, instructional objectives are determined to verify that readers have the ability to identify connections and access schemata to make sense of a text. Thus, teachers might assign a pre-reading activity where learners are encouraged to engage with a text prior to reading it. Students could examine properties such as cover design or illustrations, after which teachers could encourage them to skim the text and identify unfamiliar vocabulary and concepts by posing questions. Finally, students should draw on their experience to predict the text's main idea by completing a quiz about the pre-class session. All of these learning activities are facilitated by learning management systems such as Google Classroom, and teachers offer remote online instruction to answer questions if necessary.

The instructional objectives sought during the in-class stage in turn focus on examining students' comprehension of the text. In doing so, students were encouraged to clarify any misunderstandings related to the text through questions about what they found unclear. They were additionally required to infer the meaning of the text in small-group discussions and then to ask the group leader to present the results, allowing the members of each group to give responses on behalf of their respective groups too. Thus, teachers should play an active role as guides prompters and evaluators during the in-class reading stage. All of these learning activities were made easier by video conferencing applications such as Zoom or Google Meet. Consequently, practice with these learning activities definitely seems to be effective in fostering learners' comprehensive learning ability.

Finally, the after-class stage involves a process of synthesising the text and reflecting on it. From the learning perspective, students ought to examine the learning task as a whole before going into the classroom so that they can report and present its comprehension in class, as well as synthesise the whole text through its analysis. Meanwhile, from the instructional point of view, teachers should expand the task by asking the students to write an opinion essay. Google Classroom largely facilitates all of these learning activities. In conclusion, the

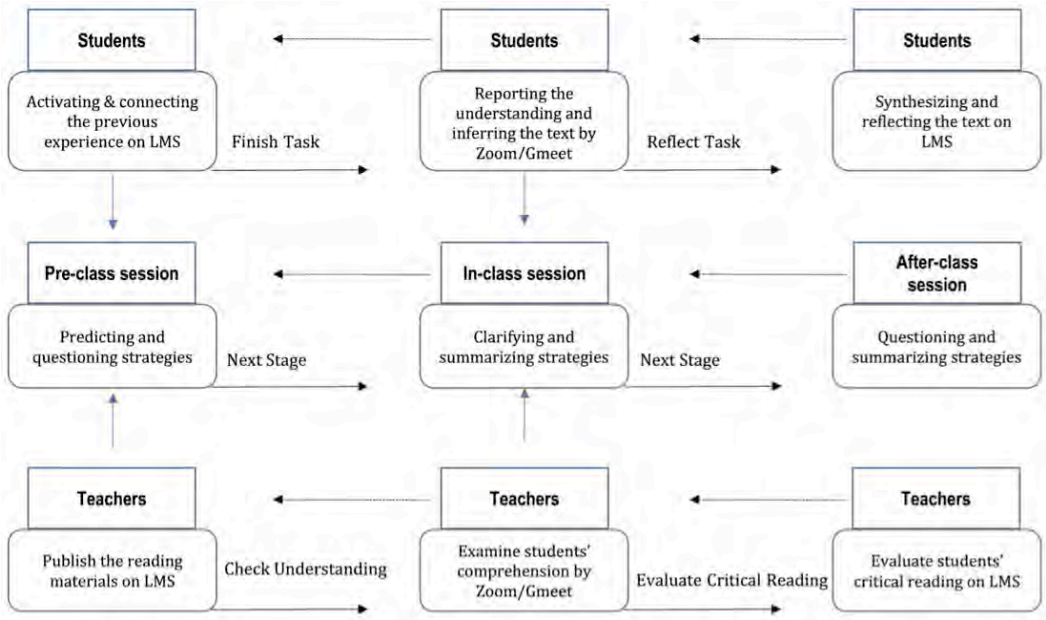

Figure 1 The Teaching Model of FCIRT

practice of such learning activities has proved effective to enhance students' critical reading comprehension.

1.4 Working Memory Capacity and its effects on Reading Comprehension

Working memory capacity (WCM), conceived as a mental work space where text information is maintained, processed, and integrated with the information from long-term memory (LTM) during and after reading, has traditionally been regarded as the success factor and accordingly played an essential role in optimising these reading performances. Researchers have linked WMC to reading comprehension as a strong predictor (Daneman & Carperter, 1980; Engle & Conway, 2004). Another study found that students with a higher WMC can comprehend texts better than those who have a lower one (Heriyawati et al., 2018). Similarly, learners who have a high WMC tend to outperform the ones with a low WMC when it comes to reading comprehension skills (Yeari, 2017). Yet, WMC also played a key role in higher-order thinking (Draheim, Harrison, Embretson, & Engle, 2018), which includes the critical reading ability. By way of example, Fleck (2008) and Opdenacker et al. (1990) claimed that WMC has a significant effect not only on the problem solving ability but also on complex problem solving (Greiff et al., 2015). It follows from these studies that WMC influences the reading comprehension ability.

Research Questions. The following three will be addressed in this paper:

1. Do differences exist in the reading comprehension ability depending on whether students learn with an extended flipped classroom model or with an OFC model?

2. Are there differences concerning their reading comprehension ability between students with a low WMC and those who have a high WMC?
3. Does the interaction between the instructional model and working memory capacity affect students' reading comprehension?

2 METHODS

Next, we elucidate the research design, including an overview of the research phases, the context and participants, as well as of the data collection process and the data analysis procedures.

2.1 Research Design

The aim of this study was to understand the influence that using an extended flipped classroom model and WMC has on students' reading comprehension ability. A quasi-experimental study with a 2 x 2 factorial design together with pre- and post-tests helped to achieve that aim (Tuckman & Harper, 2012). Two independent variables were completely crossed, resulting in four experimental conditions: WMC (high WMC vs. low WMC) and instructional model (extended flipped classroom vs. OFC). Furthermore, this research work followed a quasi-experimental design with two intact classes as control and experiment groups in which the extended flipped classroom model was adopted for the experimental group, and the original flipped classroom (OFC) for the control group (Table 1, Table 2).

Table 1 Learning activities in the original flipped classroom (OFC) for fully online environments

Learning Session	Conduction	Learning activities	Learning Technologies
Pre-class	Online Asynchronous	Students learn a foundation/basic knowledge from the text	LMS (Google Classroom)
In-class	Online Synchronous	Students comprehend the text through discussion with teacher and peers	Zoom

2.2 Participants

The study involved a total of 115 students from two groups of a first-year student reading course at the university of Brawijaya in Indonesia. Whereas students assigned to the experimental group were taught using the extended flipped classroom model, those serving as the control group received teaching based on the OFC model. To fulfil the research validity requirements, both groups were taught in the same courses and during the same time period. We informed every participant that the study was being conducted, research data being collected before and after the implementation of interventions in which they could freely choose to take part or not.

Table 2 Learning activities in the extended flipped classroom model for Fully Online Environments

Learning Session	Conduction	Learning Activities	Learning Technologies
Pre-class	Online Asynchronous	Predicting:students make a prediction from the picture.	LMS (Google Classroom)
		Questioning: students write a wh-question based on the text, choose one question from a classmate and answer it clearly.	LMS (Google Classroom)
		Quiz : Students complete the literal quiz.	LMS (Google Classroom)
In-class	Online Synchronous	Clarifying: students clarify any misunderstandings concerning the text by asking about what they found confusing/unclear.	Zoom
		Summarising: students infer the text's content in small-group discussions and ask the group leader, who presents the results in addition to allowing the members of each group to give responses on behalf of their respective groups.	Breakoutroom (Google Meet)
		Closing activity : students submit the results of group discussion.	LMS (Google Classroom)
After-class	Online Asynchronous	Questioning : Students comprehend a given individual task and are allowed to ask if necessary.	LMS (Google Classroom)
		Summarising (synthesising): Students interpret the text and write an opinion essay with a maximum length of 500 words.	LMS (Google Classroom)
		Closing activity : students upload the file of an opinion essay and submit it.	LMS (Google Classroom)

2.3 Instruments

The instruments utilised in this study included students' reading comprehension and their working memory capacity. Below can be found a description of the contents related to these tools:

In order to measure students' reading comprehension, we adopted the items of the questionnaires developed by Heriyawati et al. (2018) for Indonesian EFL students. A total of 50 multiple-choice items served as our reading comprehension test for this research work. This reading comprehension test has a high internal consistency (Cronbach's α= 0.987). As for students' WMC measurement, we decided to use the reading span test devised by Daneman and Carperter (1980), in which learners were instructed to read sets of sentences presented one by one in the middle of a screen and subsequently process each sentence and determine whether they "made sense", after which students had to recall the last word of the sentence at the end of each set. Each level included two sets of five sentences. The reading span test consisted of 54 items with a high internal consistency (Cronbach's α= 0.830). The Partial-credit Scoring technique was used to obtain the scores (Convey, Kane, Hambrick, Wilhelm, & Engle, 2005). Test results were categorised into two groups: high working memory capacity (HWMC) for scores of 28 and above; and low working memory capacity (LWMC) for scores of 27 and below.

2.4 Data Collection Process

This intervention study comprised a pre-test (week 1), implementation (weeks 2-10) and post-test (week 11). In the pre-test, both the experimental group and the control group were assessed via the reading comprehension test and the reading span test prior to implementation. During the implementation phase, the OFC model was utilised in the control group, delivering instructions through the use of online asynchronous pre-class activities and online synchronous in-class activities. The learning activities performed during the pre-class session had as their purpose to encourage students to acquire the literal comprehension of the text, while in-class ones focused on their inferential comprehension of the text (Figure 2, Figure 3).

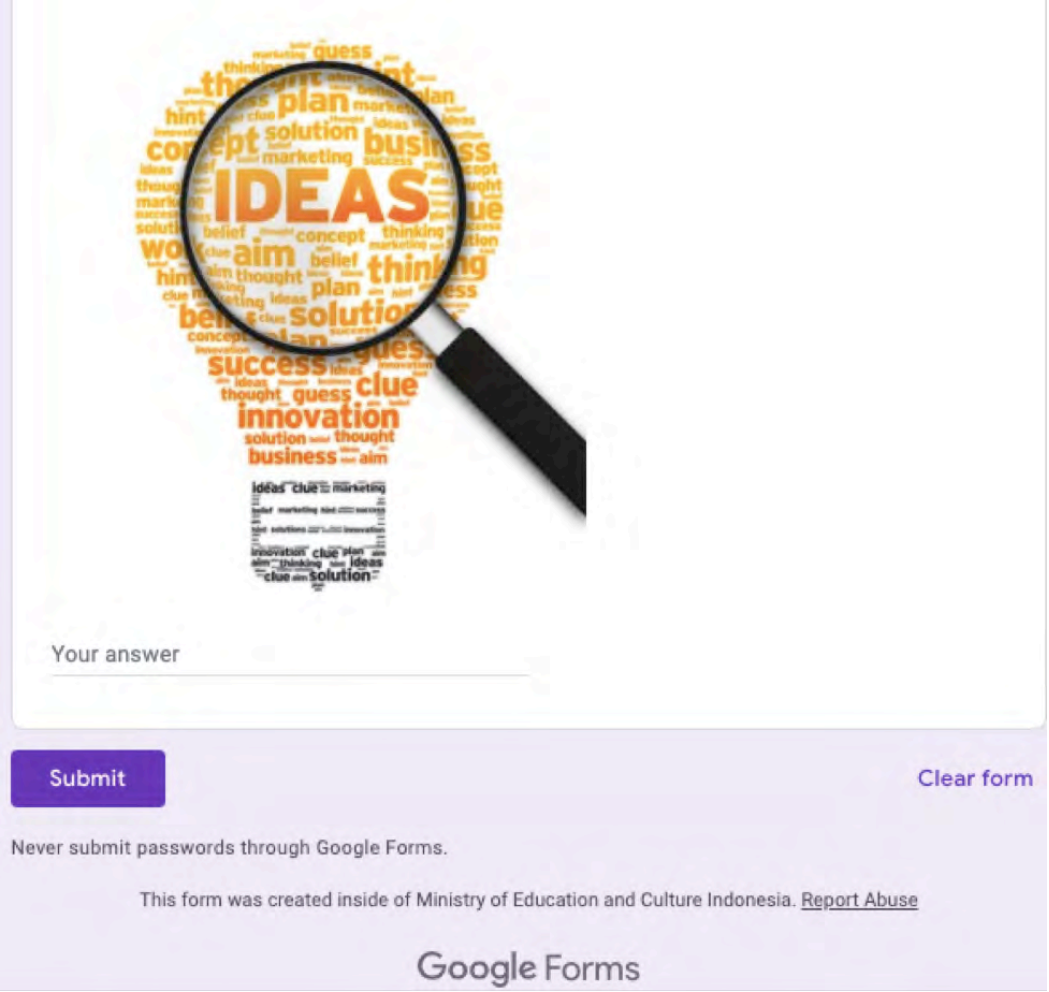

Figure 2 The example of predicting activity in the pre-class session

Meanwhile, in the experimental group, an extended flipped classroom model was adopted in which four reciprocal teaching strategies —i.e. predicting, questioning, clarifying and summarising— complemented the instructional activities. Moreover, predicting and questioning strategies were conducted in the pre-class session with the aim of encour-

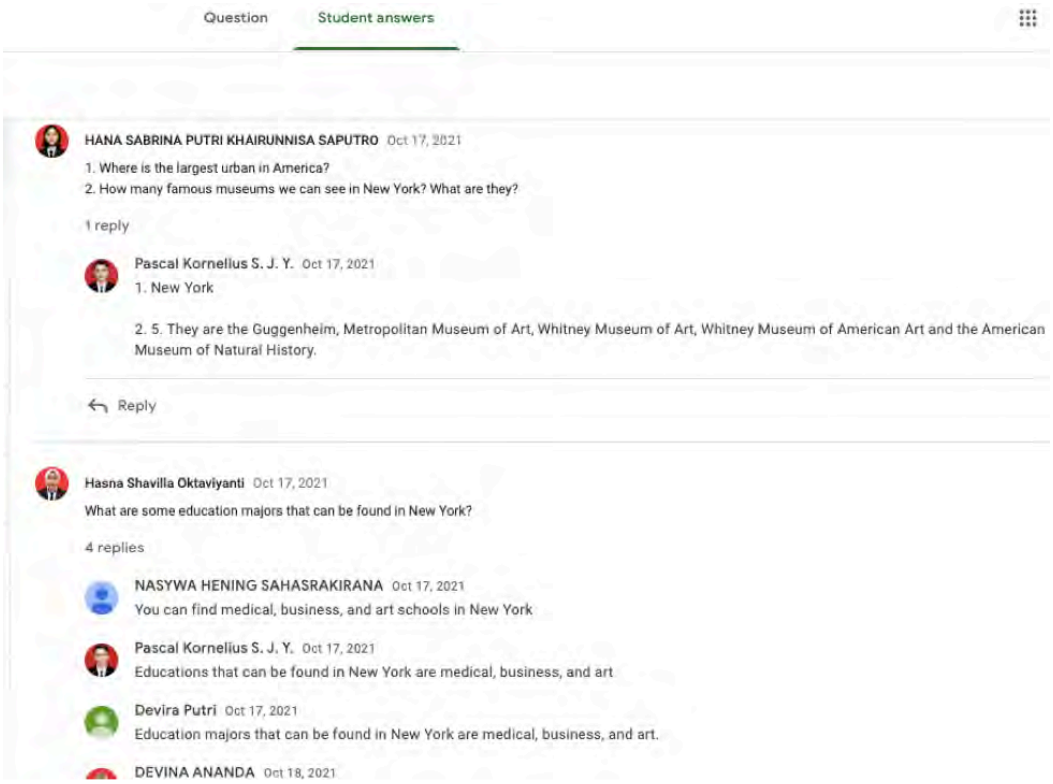

Figure 3 The example of questioning activity in the pre-class session

aging students to acquire a literal comprehension of the text; in turn, the clarifying and summarising strategies implemented during the in-class session sought to ensure that students achieved an inferential comprehension of the text. Lastly, the questioning and summarising strategies put into practice in the after-class session pursued to help learners to reach a critical text comprehension (Figures 4, 5 and 6).

Additionally, in the course of the implementation phase, a short functional reading course was received to the participants from both groups for 9 weeks. Then, in the last week, a post-test meant to assess the reading comprehension ability was administered to the two groups similarly to what had been done during the pre-test sessions (Figure 7).

2.5 Data Analysis Procedures

Only 3 out of 115 students participating in the intervention study did not complete the reading comprehension pre- or posttest, as well as the reading-span test, on account of their absence. Only the data corresponding to the 112 students who completed every assessment task were used in the final analyses. Insofar as the distribution of scores in the pre and post-test met the requirements concerning normality ($p > .05$) and variance homogeneity ($p > .05$), we reported the finding by means of a parametric test: Analysis of Variance (ANOVA). In order to answer the three research questions, we resorted to the two-way analysis of variance (two-way ANOVA), the descriptive statistics being calculated with means and standard

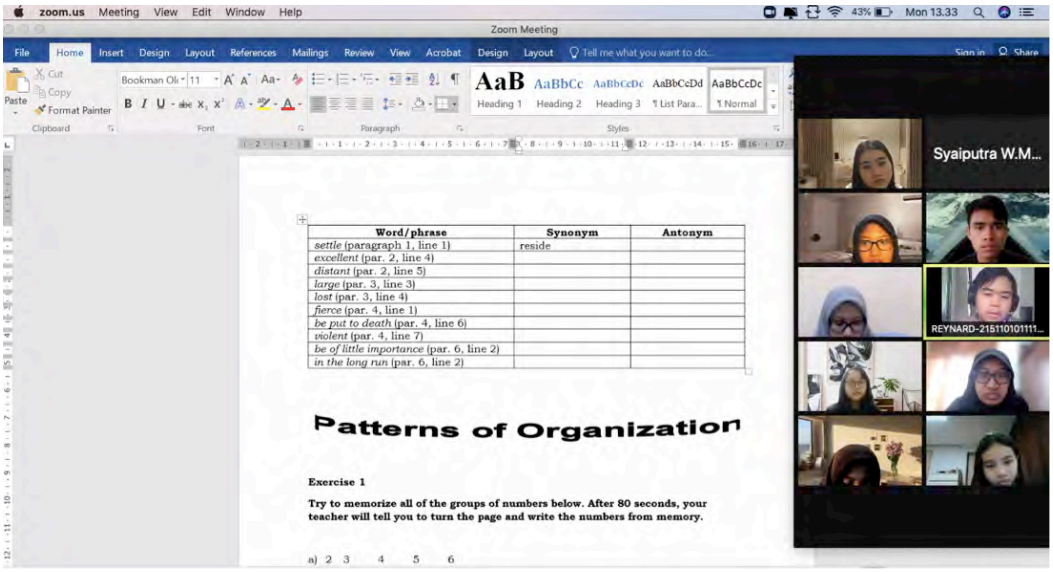

Figure 4 The example of clarifying activity during in-class session

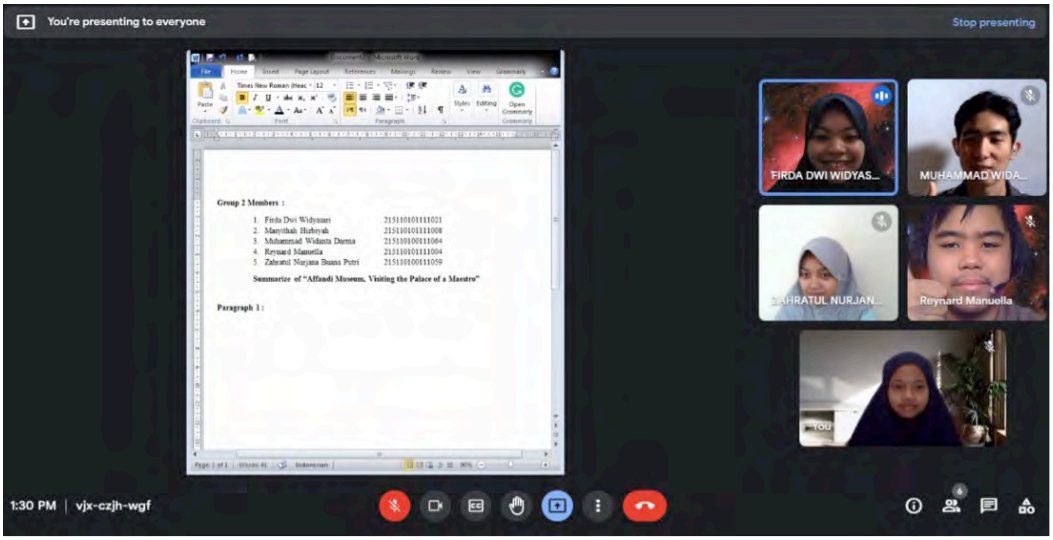

Figure 5 The example of summarizing activity during in-class session

deviations. Moreover, the calculation of the effect size (Eta square, h^2) permitted to measure the magnitude of the difference when a significant one appeared. Cohen (1988) stated that the larger the effect size the stronger the relationship between variables and suggested that the values .01, .06 and .14 denote small, moderate and large effect sizes, respectively. The data were analysed using SPSS 26 (IMB) (Table 3).

Table 3 Descriptive normality test statistics by groups and variance homogeneity

Normality Results	Group	Statistics	df	Sig.
Score in pre-test for Reading Comprehension Performance	Experimental group with a low WMC	.967	28	.499*
	Experimental group with a high WMC	.975	28	.710*
	Control Group with a low WMC	.974	28	.700*
	Control Group with a high WMC	.964	28	.428*
Score in post-test for Reading Comprehension Performance	Experimental group with a low WMC	.939	28	.102*
	Experimental group with a high WMC	.947	28	.162*
	Control Group with a low WMC	.961	28	.362*
	Control Group with a high WMC	.931	28	.065*
Variance Homogeneity Results	**Levene Statistic**	**df1**	**df2**	**Sig.**
Score in pre-test for Reading Comprehension Ability	1.016	3	108	.389*
Score in post-test for Reading Comprehension Ability	1.700	3	108	.171*

Note: * p>.05

Table 4 Reading comprehension performance statistics by groups

Group	Number of participants	Pre-test Score: Mean (SD)	Post-test Score : Mean (SD)
Control Group	56	21.39 (4.993)	31.70 (5.38)
Experimental group	56	22.91 (5.90)	34.57 (3.94)
Independent t-test		t (110)=-1.470, p=.147	
Total	112		
Students with a high WMC	56		35.02 (3.94)
Students with a low WMC	56		31.25 (5.08)
Total	112		
Students in control group with a low WMC	28		28.79 (4.66)
Students in control group with a high WMC	28		34.61 (4.442)
Students in experimental group with a low WMC	28		33.71 (4.29)
Students in experimental group with a high WMC	28		35.43 (3.41)
Total	112		

Table 5 Between-subjects effect of reading comprehension performance test by groups

	Type III Sum of Squares	df	Mean Square	F	*p*	Eta2
Instructional Model	231.438	1	231.438	12.938	.000*	.10
Working Memory Capacity	397.509	1	397.509	22.221	.000*	.17
Instructional Model & Working Memory Capacity	118.080	1	118.080	6.601	.012*	.05

Note: * p<.05

Figure 6 The example of student assignments in the after-class session

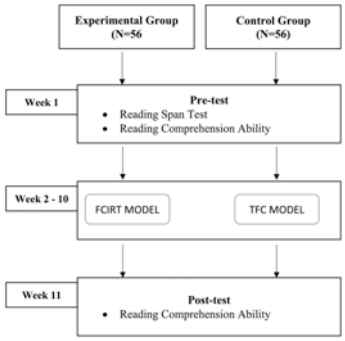

Figure 7 The Procedure used in this study

3 RESULTS

3.1 Research Question 1

As the first step, the pre-test results' descriptive statistics were evaluated to verify the potential differences in the reading comprehension ability of students depending on whether they belonged to the extended flipped classroom group or the OFC group. These statistical results showed that no significant differences existed in terms of reading comprehension ability between the control group and the experimental one prior to carrying out the experiment ($t=1.47$, $P = 0.145$, $p> 0.05$). In contrast, after nine weeks of experimentation, the results revealed a statistically significant difference in reading comprehension ability

between the extended flipped classroom group and the one following the OFC model, F (1.108) = 12.938, p = .000), as evidenced in Table 5. The results also showed a moderate effect size in the instructional model, h^2 = .10. Furthermore, the extended flipped classroom group members had a higher reading comprehension ability (M=34.57, SD=3.94) than the participants belonging to the OFC group (M=31.70, SD=5.38).

3.2 Research Question 2

In view of the results revealed, a significant difference in reading comprehension ability existed between students with a high WMC and those with a low WMC, F (1,108) = 22.221, p = .000), as can be seen in Table 5. Likewise, the results showed a large effect size in WMC, h^2 = .17. Furthermore, the mean scores for the post-test on reading comprehension ability were significantly higher for students with a high WMC (M=35.02, SD=3.94) compared to those who had a low WMC (M=31.25, SD=5.08).

3.3 Research Question 3

The quantitative evidence supplied in response to RQ 3 acquires statistical significance. It was found that the combination of instructional model and WMC had an effect on students' reading comprehension ability, F (1, 108) = 6.601, p=0.12 (See Table 5). The results also showed a small effect size in the interaction between instructional model and WMC, h^2 = .05. Furthermore, the mean scores for learners with a high WMC were relatively close in both groups: 34.61 in the control group and 35.43 in the experimental one. However, the mean scores for students with a low WMC differed to a certain extent between one group and the other, being lower for learners with a low WMC in the control group (28.78) and higher for their counterparts with a low WMC placed in the experimental one (33.71).

4 DISCUSSION

Increased attention to the learning activity that unfolds in fully online environments has been accompanied by the emergence of a flipped classroom instructional model for fully online teaching and learning. Reading comprehension encompasses examining a text and reading between the lines, which in turn entails higher-order thinking skills Teo (2012). This study investigated the design and effectiveness of the extended flipped classroom model when it comes to achieving the goals of reading comprehension. The extended flipped classroom model was systematically structured by adopting the flipped classroom model proposed by He (2020), complemented with the reciprocal teaching strategy developed by Palinscar and Brown (1984) and conducted fully online. The administration of pre-test scores proved that there were no differences in students' average reading comprehension ability before the implementation of our experiment.

The extended flipped classroom model had a significant effect on students' reading comprehension ability. Whereas the students in the control group showed little improvement across the intervention period, their experimental group counterparts achieved a remarkably high ability in reading comprehension. Findings suggested that the extended flipped

classroom model, which conducted its learning activities fully online through asynchronous technology, using resources such as Google Classroom, and synchronous technology apps —e.g. Zoom— proved effective in enhancing learners' reading comprehension skills. The results corroborate those obtained in previous studies, showing that the flipped classroom model (Hashemifardnia et al., 2018; Y. N. Huang & Hong, 2016; Mo & Mao, 2017; Sage & Sele, 2015; Samiei & Ebadi, 2021) and the reciprocal teaching strategy (Doolittle et al., 2006; Palinscar & Brown, 1984; Yang, 2010) facilitate the enhancement of students' reading comprehension. Furthermore, the flipped classroom in which learning activities were carried out fully online with the help of asynchronous technology resources such as LMS and synchronous technology apps —e.g. Zoom— appeared to be effective in improving students' performance (Hew, Jia, Gonda, & Bai, 2020). For example, a study by Reflianto, Setyosari, Kuswani, and Widiati (2021) showed that a flipped classroom developed in a fully online setting through an online platform such as Microsoft teams can provide better performances in reading comprehension. In terms of the application of the reciprocal teaching strategy online, C. T. Huang and Yang (2015) revealed that implementing the reciprocal teaching strategy within online environments significantly improved students' reading comprehension.

Findings additionally made clear that students with a high WMC outperformed those whose WMC was low in reading comprehension. Our findings are supported by studies showing that students who have a low WMC were associated with slow word recognition and slow reading speed —considered reading problems. Instead, learners with a higher WMC not only tackle linguistic tasks more efficiently but also have additional resources to strategically promote higher-level comprehension processes (Li & Brantmeier, 2021) . Another study also verified that students with a high WMC own enough linguistic knowledge and background knowledge to read and understand the text without much difficulty; however, students whose WMC is low lack the prior knowledge that could help them to understand the contents of texts (Heriyawati et al., 2018). With regard to text reading in online settings, a research work found that high-WMC learners achieved better results than their counterparts with a low WMC at text comprehension; a low MWC makes it difficult to access related information from working memory, especially when text complexity is high (Schurer, Opitz, & Schubert, 2020). These authors also highlighted that prior knowledge benefits subsequent text comprehension. As a result, we can draw the conclusion that students comprehend a text better when they have enough prior knowledge and use higher-level comprehension process.

Interestingly, these results revealed that the instructional model and WMC affect students' reading comprehension simultaneously. Low-WMC learners show good reading comprehension skills when they have been taught through the extended flipped classroom model, compared to those instructed under the OFC model. This leads us to argue that the extended flipped classroom includes asynchronously conducted pre-class learning activities which allow students to acquire a large amount of foundational knowledge via predicting and questioning in relation to the text. This finding resonates with earlier research works stressing that, during the in-class stage, higher-order activities and thinking are built upon

having a good volume of foundational knowledge, which comes from the pre-class learning activity stage (Han & Klein, 2019).

Likewise, we argue that the extended flipped classroom model incorporates in-class learning activities conducted synchronously using the Zoom app which prepare students to comprehend a text by clarifying and summarising it through collaboration with teachers and peers. This is supported by studies according to which, when the class structure and activities using such video conferencing apps as Zoom are designed following clarity and cohesion criteria, this could prove as effective as the in-class learning stage conducted in a face-to-face class (Hew et al., 2020). Another research work devoted to online asynchronous and online synchronous learning stressed that students who engaged more actively in the asynchronous learning stage tended to participate to a greater extent during the synchronous learning stage, had better understanding the concepts and obtained a higher grade (Lin, Hung, Kinshuk, & Chen, 2019). It must be added to all of the above that the extended flipped classroom model envisages an after-class stage conducted asynchronously through Google Classroom that helps students to summarise, evaluate and reflect on texts —tasks regarded as belonging to higher-order thinking processes— thus ensuring a deeper and better text comprehension. Finally, this is also in keeping with the results of the studies undertaken by He (2020), Wang, Huang, Schunn, Zou, and Ai (2019) and Persky and Mclaughlin (2017).

As for the cognitive factors, the cognitive load theory helps to explain the findings related to the interaction effect in this study. By way of example, the flipped classroom effectively proved not only to produce deeper information processing but also to promote higher-order, in-depth thinking in the content-based second language through the asynchronous and synchronous learning stages. This conclusion matches the results obtained in the research performed by Tonkin, Page, and Forsey (2019): students experienced in the pre-class stage can reduce the intrinsic load during the in-class stage because having completed the pre-class activities endows them with sufficient prior knowledge to carry out in-class learning tasks with greater ease. Moreover, prior knowledge not only permits to reduce students' cognitive load during the in-class learning activity but also improves their performance. Not in vain, prior knowledge is defined as the information or experiences that a learner has already established in relation to a new topic; and this knowledge positively correlates with learning outcomes. The results of the structural equational modelling exercise conducted by Song, Kalet, and Plass (2016) and Lu and Cutumisu (2022) evidenced that prior knowledge directly affects learning performance. Furthermore, Lu and Cutumisu (2022) stated that students with little or no prior knowledge will find themselves at a disadvantageous position when they have to process and memorise entirely new information.

5 CONCLUSIONS AND IMPLICATIONS

To finish with, the research clearly suggests that the integration of the reciprocal teaching strategy into the flipped classroom model conducted in fully online contexts is a promising approach to enhance students' reading comprehension, especially for those with a low

WMC. This research has similarly made clear that learners' preparedness prior to the class becomes crucial; hence the need for the instructor to monitor the pre-class learning activities as an effective way to ensure students' engagement and task completion. However, since the extended flipped classroom model is new, future studies might consider undertaking in-depth qualitative study with the aim of maximising all the possible benefits that might result from using the extended flipped classroom model.

Several practical implications can be drawn from this research. Firstly, setting up an extended flipped classroom model has the potential to replace or complement the original flipped classroom model, insofar as it can prove more effective in improving students' reading comprehension than OFC. Secondly, considering the essential element that largely contributes to a successful extended flipped classroom model —i.e. students' engagement— teachers play a crucial role in the extended flipped classroom model by providing support to learners during the pre-class, in-class, and after-class sessions. Thirdly, an extended flipped classroom model requires the use of high technological tools; hence the need to ensure that both teachers and students have access to the appropriate technology. Regarding theoretical implications, this research confirms that the extended flipped classroom model is more effective in improving students' reading comprehension ability than the original flipped classroom model because, as claimed by Shahnama, Ghonsooly, and Shirvan (2021), the extended flipped classroom model makes it possible to enhance students' achievements if appropriately designed and implemented. Therefore, the integration of reciprocal teaching strategies into the flipped classroom model must be taken into consideration when designing and implementing flipped instruction in reading courses.

According to our findings, the effects of the extended flipped classroom model on students' reading comprehension ability are promising, especially for those with a low WMC. However, our research work faced several limitations. Firstly, it was relatively short in duration (9 weeks). We therefore urge future researchers to examine the utilisation of an extended flipped classroom model over a longer time period (e.g. one semester or a whole academic year) to verify our results. Secondly, this study involved only a small sample of students who completed the entire assessment. It is recommended for future researchers to replicate the study with a variety of other subject areas, as well as to include larger sample sizes. Thirdly, this research used a single moderator variable —WMC. Examining other moderator variables, amongst them self-efficacy and self-regulated learning, could also be interesting. Fourthly, an extended flipped classroom model requires high technological tools. Future research ought to replicate this study in face-to-face settings during the in-class session. In any case, all these limitations will probably be addressed during future studies carried out along these same lines.

6 AUTHORS' CONTRIBUTIONS

Syaiputra W.M Diningrat., Punaji Setyosari., and **Saida Ulfa**: Conceptualization, Methodology, Writing-original Draft. **Syaiputra W.M Diningrat** and **Utami Widiati**: Data Curation, Writing-Review & Editing. **Punaji Setyosari**: Software, Formal Analysis.

Saida Ulfa: Visualization, Validation. **Utami Widiati**: Investigation. **Punaji Setyosari., Saida Ulfa., and Utami Widiati**: Supervision. **Syaiputra W.M Diningrat** and **Saida Ulfa**: Project Administration, Resources.

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